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(54) Automotive arc headlamp with reduced UV emission.

(57) Automotive headlamp assemblies employing an arc discharge lamp 28 which emits both visible and UV radiation as the light source and which have a UV degradable plastic lens 26, such as polycarbonate, have a UV absorbing coating 24 disposed on both the reflecting surface and interior surface of the lens to protect the lens from UV degradation.

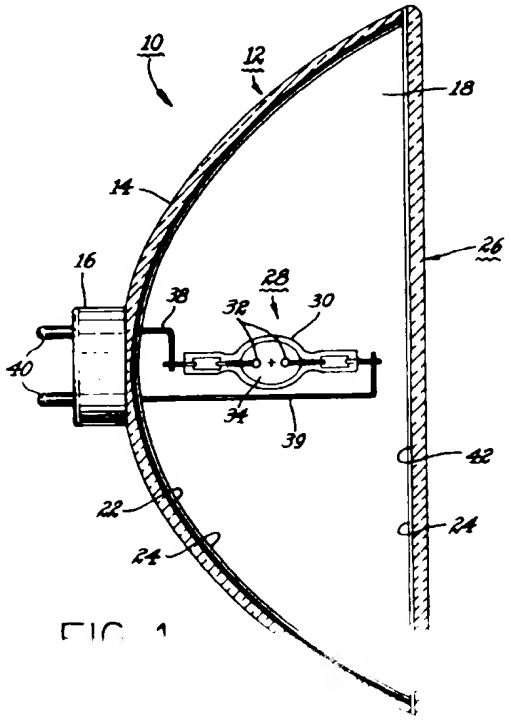

FIG. 1

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BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to an automotive arc discharge headlamp having reduced ultraviolet (UV) emission. More particularly, this invention relates to an automotive headlamp comprising a forward projecting reflector with a light transmissive lens mounted on the forward end and enclosing an electric arc discharge lamp within as a light source, wherein the reflecting surface of the reflector is coated with a UV absorbing coating.

Background Of The Disclosure

There is much interest in the automobile industry in using arc lamps also known as arc discharge lamps as the light source for automotive headlamps. Tungsten-halogen lamps are presently used, but arc lamps have potentially longer life, higher light output and much higher source brightness. The small size of the arc lamps and concomitant reflector and lens assembly provide automotive manufacturers a greater leeway in innovative front end automotive design. Arc discharge lamps useful for automotive applications are basically miniature metal halide arc discharge lamps. One of the disadvantages associated with such lamps for automotive use is that they emit a significant amount of UV radiation. Emission of UV radiation by automotive headlamps is undesirable because of its adverse effect on human eyes and skin. Further, miniature automotive headlamps employing arc discharge lamps are often plastic and have plastic lenses. Plastic lenses are easier to fabricate than glass into more complex shapes for automotive styling. Plastic is more flexible than glass and can possess greater impact resistance. Polycarbonate is the plastic of choice for such lenses because of its clear, visible light transmissive properties along with excellent impact and abrasion resistance. Unfortunately, polycarbonate and other plastics turn yellow or brown and/or become hazy when exposed to UV radiation.

Accordingly, a need exists for automotive arc headlamps having reduced UV emission, particularly when the headlamps employ plastic reflectors and plastic lenses.

SUMMARY OF THE INVENTION

The present invention relates to a reflector and lamp assembly employing an arc discharge lamp which emits UV radiation as the light source and [illegible] face of the reflector to reduce the amount [illegible] diation projected forward of the reflector. Such lamp and reflector combinations have been made without the presence of a lens on the open, visible light projecting end of the reflector, wherein less than 10% of the UV radiation emitted by the lamp is projected forward of the reflector due to absorption of the UV by the coating on the reflecting surface. In one embodiment, the lamp will employ a light transmissive lens made of a material which is degraded by UV radiation. In such an embodiment, it is preferred that the interior surface of the lens also has disposed on it a coating which absorbs UV radiation. Thus, another embodiment of the present invention relates to an automotive headlamp assembly comprising an arc discharge lamp which emits both UV and visible light radiation enclosed within a forward projecting light reflector which has a light transmissive lens at one end that is degraded by UV radiation, with a UV absorbing and visible light transmissive coating on the interior reflecting surface of the reflector and on the interior surface of the lens.

By UV radiation is meant radiation having a wavelength generally below about 400 nm. UV radiation having a wavelength of about 120 nm or less is known to have a detrimental effect on human eyes while that having a wavelength of about 140 nm or less will degrade polycarbonate plastic causing it to turn yellow and/or become hazy, depending on the wavelength. Accordingly, the UV absorbing coating should be selected so as to absorb UV radiation having a wavelength equal to or below about 140 nm and at the same time be substantially nonabsorbent and transparent to visible light radiation. The coating must also be somewhat heat resistant due to its presence inside the interior cavity of a sealed automotive headlamp reflector wherein operation of the arc discharge lamp can heat the inside of the reflector to a temperature of 150°C and more. Proprietary coatings commercially available on the market comprising one or more silicone resins in which is dissolved or dispersed a UV absorbing material have been found satisfactory for use with the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 schematically illustrates a plastic lens,reflector, and lamp assembly useful in the practice of the present invention with the reflecting surface coated with a UV absorbing coating.

Figure 2 is a graph illustrating the UV attenuation factor as a function of wavelength using a reflector similar to that in Figure 1 containing a UV absorbing coating on the interior reflecting surface, but without a lens.

Figure 3 is a graph illustrating the UV spectral out [illegible]

DETAILED DESCRIPTION

Turning to Figure 1 there is shown automotive

headlamp reflector assembly 10 comprising all plastic molded reflector 12 consisting of a parabolic or elliptical reflecting portion 14, open at its forward projecting end 18 and terminating at its rear end in an integrally molded base portion 16. The interior surface of reflector 12 is coated with a thin, light reflecting, shiny coating of aluminum 22 over which is disposed UV absorbing coating 24. Coating 24 is clear and is substantially transparent and non-absorbing to radiation in the visible light region, but absorbs radiation in the UV region (i.e., < 400 nm). The forward end 18 of reflector 12 is hermetically sealed with plastic lens 26 which is transparent to visible light radiation. In an embodiment where lens 26 is made of a plastic which is degraded by UV radiation, such as a polycarbonate which has excellent light transmission, strength, impact and abrasion resistance and which is often the plastic of choice for such applications, the interior surface 42 of the lens is also coated with UV absorbing coating 24 to insure that little or none of the UV radiation emitted by lamp 28 reaches the plastic lens. It should be noted that if lens 26 is glass, then no coating would be necessary since glass is a natural absorber of UV radiation and its transparency to visible light radiation is unaffected by exposure to UV radiation. Miniature arc discharge lamp 28 is enclosed within assembly 10 with its optical center approximately coinciding with the focal point of reflector 12. Lamp 28 comprises a synthetic quartz envelope 30 enclosing within electrodes 32 hermetically sealed within arc chamber 34 as is well known to those skilled in the art. Arc chamber 34 also contains, as is known to those skilled in the art, a small amount of mercury along with one more more metal halides and an inert starting gas, such as xenon. Lamp 28 is connected by means of mount wires 38 and 39 to base portion 16 (by means not shown) and thence to terminal pins 40 for connection to a source of electric current. In automotive applications, a metal shield (not shown) will be employed in front of the forward end of the lamp to insure that all of the light projected forward of the reflector is reflected from reflecting surface 22. Such metal light shields and their uses in association with such lamps are known to those skilled in the art and examples may be found, for example, in U.S. Patents 4,795,939 and 4,754,373.

UV absorbing coatings for protecting UV degradable plastics from UV radiation are commercially available and may be obtained from coating manufacturers and suppliers such as the Silicone Division (GE Silicones) of GE Plastics in Waterford, N.Y., Dow Corning, DuPont, Sherwin Williams, Bee Chemical Company and the like. Such coatings are clear and [illegible] visible region of the spectrum (i.e., 400-750 nm). These coating materials contain a UV absorber for absorbing radiation in the UV portion of the spectrum (i.e., < 400 nm). Heat-resistant coatings are preferred for use in the present invention. Heat resistant coatings and also heat resistant UV absorbers are generally based on silicone containing compounds or at least contain such compounds. Illustrative, but non-limiting examples of both coatings and UV absorbers containing silicone compounds and suitable for use in the present invention are disclosed and claimed, for example, in U.S. Patent Nos. 4,374,674; 4,278,804; 3,986,997; 4,177,315 and 4,644,077, the disclosures of which are incorporated herein by reference.

Although the examples and disclosure of this invention have been directed mostly to automotive types of applications, the invention is not meant to be so restricted. Thus, the invention may also be used for spotlight and general illumination types of lighting applications, with elliptical or parabolic shaped reflectors, with or without a plastic lens, etc.

EXAMPLES

In one experiment, reflector and lamp assemblies similar to those illustrated in Figure 1 and described above, (with the exception that the forward, light projecting end of the reflector was open and not covered with a lens) were assembled. The reflector was parabolic having a 7/8 inch focal length and arc lamp 28 was a miniature, 30 watt lamp intended for automotive applications. The aluminum reflecting surface 22 was coated by the manufacturer with an 8 micron thick coating of a clear, essentially non-UV absorbent coating material designed to prevent corrosion and dulling of the highly light reflective aluminum coating. This coating material is a proprietary acrylic composition, ET4, obtained from the Red Spot Paint & Varnish Company. Some of the reflectors were then top-coated with two different commercially available coating materials used to protect plastics, particularly polycarbonate plastics, from UV degradation. These two coating materials, LTC5000 and LS123, were obtained from Bee Chemical Company and are believed to be organic resins containing a UV absorber. One of these is based on a urethane/melamine organic resin, and the other is of unknown composition. The recommended thickness for these coatings are 1.6 mils and 0.20 mils, respectively. The 30 watt miniature metal halide arc lamps were assembled into the reflectors with the arc center at the focal point, and the arc lamp was then energized. An ultraviolet spectral energy distribution was measured in the projected beam, 50 cm from the front of the reflector, with an Optronic Laboratories, Inc., Model 742, Spectroradiometer. The results of the measurements [illegible] function of wavelength. Figure 1 illustrates the spectrum of the lamp projected forward of the reflector with no UV absorbing coating.

Turning to Figure 2, the attenuation factor at each wavelength was computed by taking the ratio of the

measurements for reflectors with organic UV absorbent coatings to those without UV absorbent coatings. In another experiment, UV transparent flat quartz plates were coated with either ET4, or a clear coating material, AS4000, obtained from GE in Waterford, New York, based on silicones, which contained a UV absorber. The thickness of this coating was about 0.22 mils. Transmission versus wavelength for the sample plates was measured. Also plotted in Figure 2 is the square of the measurements at each wavelength to simulate the attenuation characteristics of these two materials on a reflector surface, where radiation from the arc source makes two passes through the coating.

The top curve, curve A, represents a reflector having only the aluminum protective coating ET4, which exhibited little attenuation or absorption of UV radiation above 300 nm. Curves B, C and D represent reflectors having the GE AS4000, Bee Chemical LS123 and Bee Chemical LTC5000 UV absorbing coatings respectively, over an ET4 coated reflector. It is immediately obvious from curve B that the GE coating AS4000 absorbed essentially all of the UV radiation below about 350 nm, whereas one of the Bee Chemical coatings LS123 represented by curve C, absorbed almost all of the UV radiation below about 360 nm, and the other Bee Chemical coating LTC5000 represented by curve D, absorbed almost all of the UV radiation below about 380 nm. This indicates that a UV absorbing coating system, completely satisfactory for initial performance, can be achieved using any of these three coatings on the reflecting surface and/or on a polycarbonate lens to avoid degradation of the lens. However, life tests revealed that the LTC5000 coating turned yellow and started to peel off the reflector after 1000 hours of lamp operation. No objectionable degradation of the other two materials was observed in over 2000 hours of life testing.

Claims

1. A lamp and reflector assembly wherein said lamp emits both UV and visible radiation and is mounted within said reflector, said reflector having an internal reflecting surface for reflecting said radiation forward of said reflector and having a UV absorbing coating disposed on said reflecting surface for absorbing UV radiation emitted by said lamp.

2. The assembly of claim 1 wherein said UV absorb- [illegible] coating [illegible] substantially [illegible] transparent [illegible] visible light radiation.

3. The assembly of claim 2 wherein the optical center of said lamp is located at about the focal point of said reflector.

4. The assembly of claim 3 wherein said lamp is an arc discharge lamp.

5. The assembly of claim 4 wherein said lamp is a miniature arc discharge lamp.

6. A lamp and reflector assembly according to any one of claims 1 to 5, said reflector having a forward light projecting end, and a plastic lens mounted on said forward end of said reflector and made of a light-transmissive plastic which is degraded by said UV radiation.

7. The assembly of claim 6 wherein a UV absorbing coating is disposed on that surface of said lens which is interior of said assembly.

8. The assembly of claim 7 wherein said UV absorbing coating on said lens is substantially non-absorbent and transparent to visible light radiation.

9. The assembly of claim 8 wherein said lamp is a miniature metal halide arc discharge lamp.

10. A lamp, reflector and plastic lens assembly according to any one of claims 6 to 9, for an automobile, wherein said lamp is an arc discharge lamp with the optical center of said lamp at about the focal point of said reflector.

11. The assembly of claim 10 wherein a light shield is disposed between said lamp and said lens to insure that substantially all of said forward projected visible light is projected from said reflecting surface.

12. The assembly of claim 10 wherein said reflector is made of plastic.

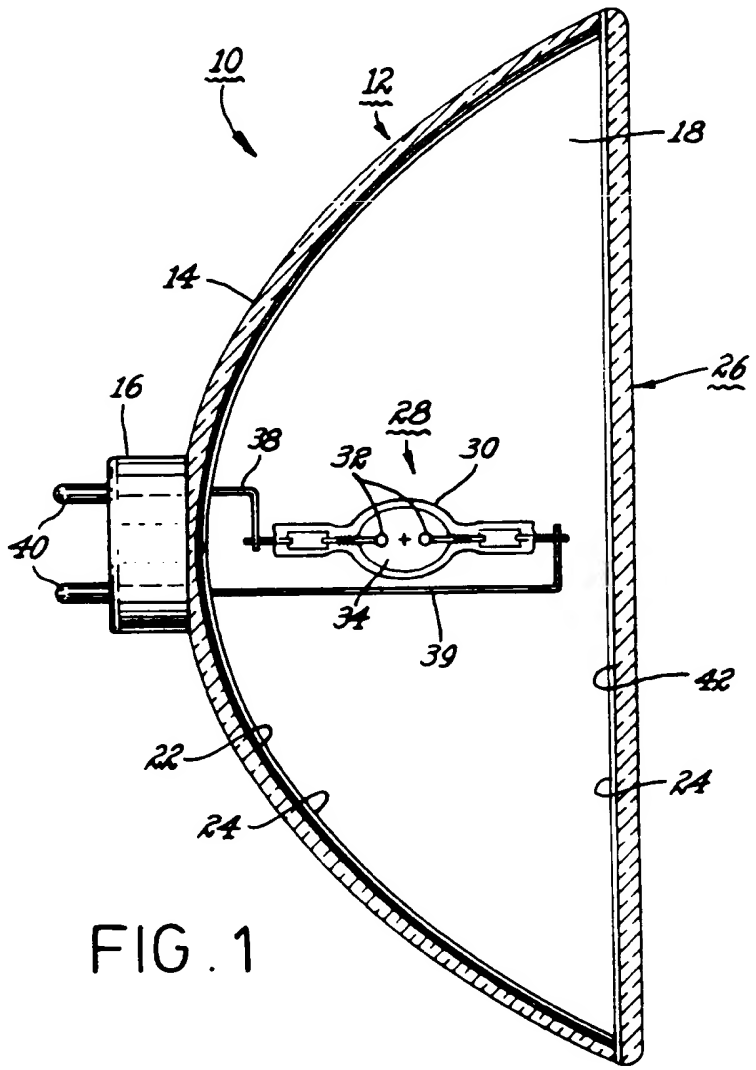
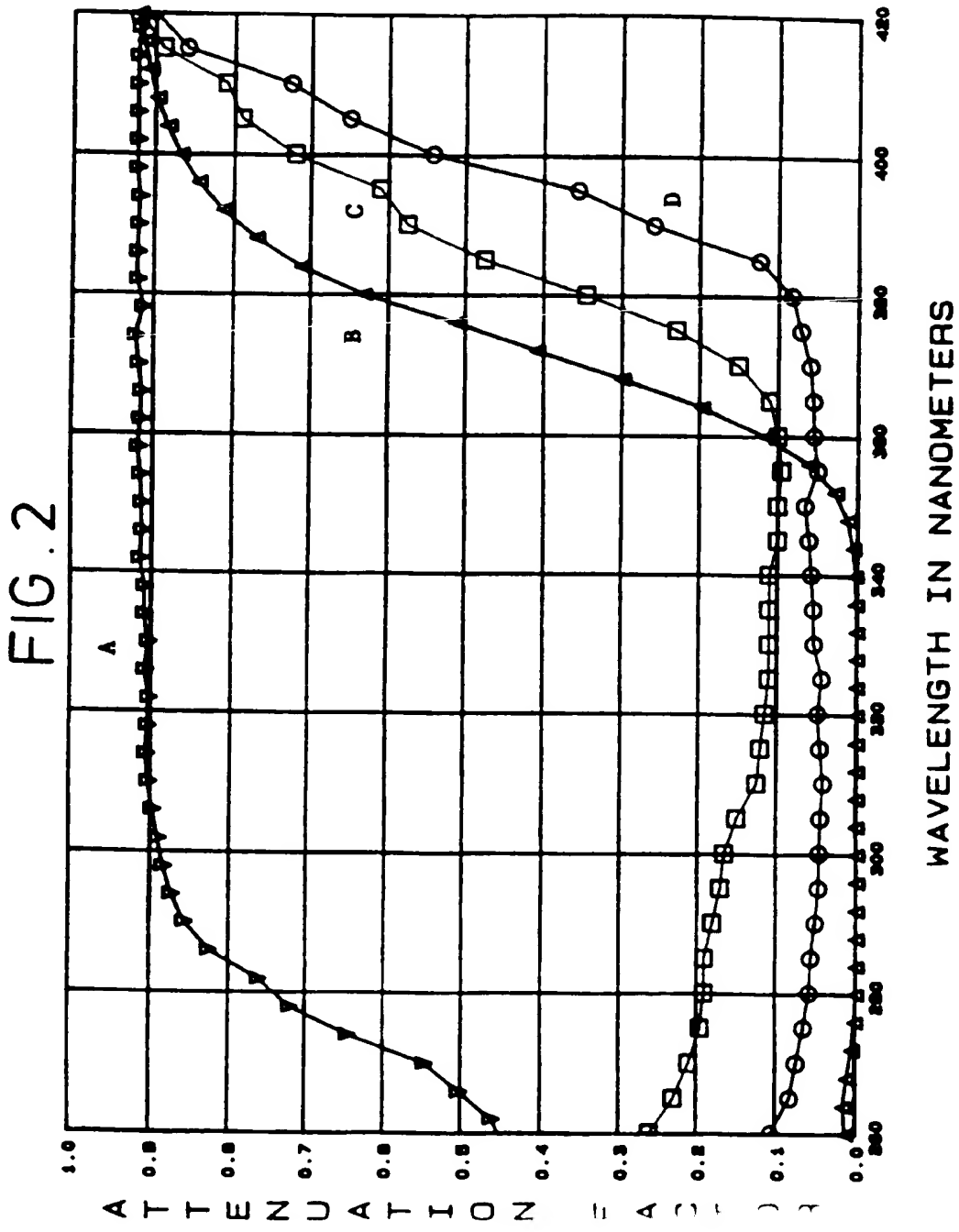


FIG. 1


A
B
C
D
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0.3
0.2
0.1
0.0
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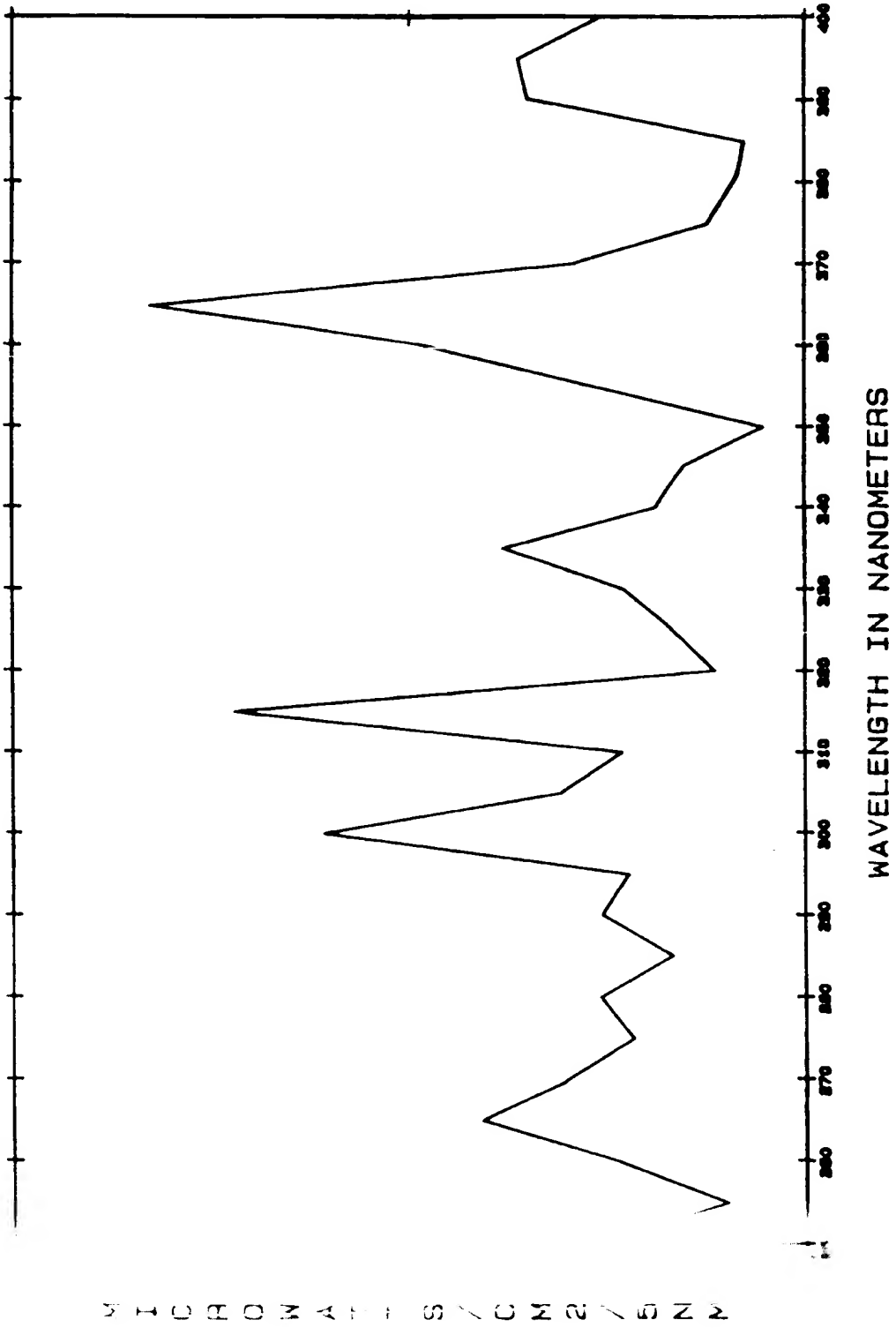
400
380
360
340
320
300
280
260
WAVELENGTH IN NANOMETERS

FIG. 2

FIG. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 92 30 2221

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,P	DE-A-4 128 906 (KOITO MFG LTD) * figure 18 *	1-5,7-12	F21V9/06
Y	US-A-4 604 680 (LEVIN) * figure 1 *	1-5,7-12	
Y	EP-A-0 043 114 (GTE PRODUCTS CORPORATON) * abstract; figure 1 *	1-5,7-12	
A	US-A-4 524 299 (PRESTON) * abstract; figure 1 *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F21V

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 JULY 1992	Onillon C.G.A.

CATEGORY OF CITED DOCUMENTS

- particularly relevant if taken alone
- particularly relevant if combined with another document of the same category
- A : technological background
- O : non-written disclosure
- P : intermediate document
- T : theory or principle underlying the invention
- E : earlier patent document, but published on, after the filing date
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